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(54) IMPROVEMENTS IN INJECTION MOULDING MACHINES

(71) I, KATASHI AOKI, a Japanese National of 6037, Oaza Minamijo, Sakaki-machi, Hanishina-gun, Nagano-Ken, Japan, do hereby declare the invention for which I pray that a patent may be granted to me and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to injection moulding machines.

With some present injection moulding machines it is usual that, when the moulded products are removed from the metal moulds of the machine, the moulded products are removed from the metal moulds of the machine, the moulded products have excess portions of plastics material attached to them, these excess portions corresponding to the sprues. Since the sprue portions of the moulded products are normally useless and must therefore be removed, it is desired that these portions should be cut off and various proposals have been made for cutting off these excess portions.

Among the previous proposals are those which have included one or more cut-off elements which have been moved to a retracted position under the injection pressure of the plastics material at the start of an injection cycle and which have moved into a closed position under the action of a spring after completion of an injection operation. Although the sprue portions of the moulded products have been removed irregular surfaces have been formed near the cut-off sprue portions.

It is accordingly an object of the present invention to provide a nozzle for attachment to the injection tube of an injection moulding machine designed to avoid the disadvantages referred to above.

It is a further object of the present invention to provide an improved injection moulding machine.

According to one aspect of the present invention there is provided a nozzle for attachment to the injection tube of an injection moulding machine, the nozzle including a nozzle body providing a passageway for the flow of plastics material, heating means for heating said nozzle body and thus said plastics material, said passageway having an inlet end and an outlet end aligned along a common axis, a part of the nozzle body extending into said passageway from the wall thereof between said inlet and outlet ends, said part being hollow and providing an inner chamber, an elongated closing member extending along said axis, and having one end located within said inner chamber, the closing member extending from said one end through the wall of said inner chamber provided by said part and into said passageway in a direction towards said outlet end, the closing member being slidable axially in sealing relationship with said part between a projected position in which it extends from said nozzle through said outlet end thereof and a retracted position in which it is retracted from said projected position towards said part, a further pasageway in said nozzle body extending transversely to said axis from said inner chamber to the exterior of the nozzle body, said one end of the closing member within said inner chamber being acted on by a lever which extends from said inner chamber through said further passageway to a position outside of said nozzle body, said lever being connected outside the nozzle body to motor means supported by the nozzle body, and arranged to impart said axial motion to the closing member via said lever.

According to another aspect of the present invention there is provided an injection moulding machine which includes an injection tube having heating means, at least one mould having a filling port, and a nozzle according to the first mentioned aspect of the invention, detachably mounted on one end of said injection tube, said filling port of the mould having a mouth with which an end portion of said closing member remote from said one end thereof can co-operate to close the filling port in the projected position of the closing member after completion of the injection of plastics material into the mould.

An embodiment of the invention will now be described by way of example with refer-

ence to the accompanying drawings in which:

Figure 1 is a sectional view of an injection moulding machine according to the invention having one form of nozzle including a closing member in its retracted position;

Figure 2 is a view similar to Figure 1 but showing the closing member in its closing position;

Figure 3 is a cross-sectional view along the line III-III in Figure 1;

Figure 4 is a perspective view of the nozzle of the machine shown in Figures 1 to 3, and

Figure 5 shows sectional views of two examples of the moulded products obtained using the injection moulding machine of the present invention.

The injection moulding machine shown in Figures 1 to 4 includes an injection tube 1 of conventional construction having heaters (not shown) on the outer surface thereof and a feeding screw contained in an axial bore in the tube 1. There is a nozzle 2 detachably mounted on the output end of the injection tube 1. The nozzle 2 includes a passageway 3 which is aligned axially with the bore of the injection tube 1 and the diameter of the passageway 3 is reduced at the forward end thereof to provide a delivery portion in the form of a cylindrical bore.

Within the delivery portion of the passageway 3, a rod 4 having a smaller diameter than that of the delivery portion is provided and forms part of a closing member. A plurality of guiding projections 4_a are formed integral with the rod 4 to maintain the rod 4 centrally of the delivery portion with the guiding projections 4_a on the rod 4 touching the inside surface of the delivery portion of the passageway 3. With this arrangement the plastics material can be passed from the injection tube 1 through the passageway 3 into the space around the rod 4.

The forward end 6 of the rod 4 is of a frusto-conical configuration having a taper which fits into a filling port 7 provided in the metal mould 5 and arranged so that it has a tapering mouth arranged to co-operate with the frusto-conical end portion of the rod 4.

When the rod 4 is advanced to its closing position, as hereinafter described, the cavity 8 inside the metal mould 5 is separated from the filling port 7 by the end surface of the frusto-conical end portion 6 aligning with the surrounding edge *a* of the cavity 8. The major part of the structure of the nozzle body is provided by a cylinder 10.

Adjacent its other end, the rod 4 passes sealingly into a part 11 of the nozzle body which part extends into the passageway 3 from the inner wall of the cylinder 10. The part 11 is hollow to provide an inner chamber 12 and said other end of the rod 4, within said inner chamber 12, has a screw-threaded connection with a reciprocable element 9 located in the chamber 12. The reciprocable element 9 is formed with a recess 15 which receives one end of a two-armed lever 14 which is freely rotatably mounted on the cylinder 10 by a pivot pin 13. The end of the other arm of the lever 14 is connected, through a link 18, to a piston rod 17 projecting from a cylinder 16. When a piston 19 is moved within the cylinder 16 by application of pressure to one side thereof or the other, the rod 4 is either advanced to close the filling port 7 or is retracted to open the port.

The nozzle 2 is provided with a number of band heaters 20 which extend around the outer surface of the nozzle so that the plasticised plastics material passing through the passage 3 and a space 21 around the projecting portion 11 of the cylinder 10 is maintained at the required viscosity. The nozzle 2 is detachably mounted on the output end of the tube 1 by engagement between an externally screw-threaded portion 22 of the cylinder 10 and an internal screw thread on the tube 1. The hydraulic cylinder 16 is mounted between a pair of supporting plates 23 which extend downwardly from the cylinder 10. The filling port 7 of the metal mould is provided on a bushing 24 detachably fitted in the metal mould.

If there is provided a plurality of different nozzles, each differing from each other and from that shown in the drawings only in the dimensions of the nozzle tip, and a plurality of corresponding bushings 24 is also provided, each dimensioned internally to co-operate with a respective said nozzle tip and all similarly dimensioned externally it will be apparent that these nozzles may be interchanged in the moulding machine, the corresponding bushings 24 in the metal mould being also changed.

With the rod 4 in its retracted position as shown in Figure 1, the plastics or plasticised material is fed through the passageway 3 into the cavity 8 of the metal mould 5. On completion of the injection operation, the rod 4 is advanced to its closing position as shown in Figure 2 in which the forward end of the rod 4 engages the surrounding wall of the filling port 7 at a position immediately adjacent the cavity 8. As a result the plasticised material inside the filling port 7 is forced into the mould and, after the closure of the rod 4 the flow of plasticised material into the mould 5 is prevented and the spilling out of the material from the mould cavity 8 is also prevented.

When moulded plastics products are produced using the apparatus described above, the sprue portion of the material normally attached to the moulded products can be completely eliminated because of the con-

struction of the closing member contained within the nozzle which is such that it can interrupt the feeding of the plasticised plastics material at a position immediately adjacent the moulding cavity.

The extent of elimination of the sprue portion of the material can be varied in accordance with the shape of the moulded products. Normally it is desired to remove the sprue portions completely from the moulded product 28 as indicated in example A in Figure 5. However, if the moulded products have a configuration which includes a projecting rib or wall 29, as shown in example B of Figure 5, one can leave a short sprue portion 30 not exceeding the height of the projecting rib or wall 29. The position of the rod 4 can be adjusted to vary the length of the remaining sprue portion.

WHAT I CLAIM IS:—

1. A nozzle for attachment to the injection tube of an injection moulding machine, the nozzle including a nozzle body providing a passageway for the flow of plastics material, heating means for heating said nozzle body and thus said plastics material, said passageway having an inlet end and an outlet end aligned along a common axis, a part of the nozzle body extending into said passageway from the wall thereof between said inlet and outlet ends, said part being hollow and providing an inner chamber, an elongated closing member extending along said axis, and having one end located within said inner chamber, the closing member extending from said one end through the wall of said inner chamber provided by said part and into said passageway in a direction towards said outlet end, the closing member being slidable axially in sealing relationship with said part between a projected position in which it extends from said nozzle through said outlet end thereof and a retracted position in which it is retracted from said projected position towards said part, a further passageway in said nozzle body extending transversely to said axis from said inner chamber to the exterior of the nozzle body, said one end of the closing member within said inner chamber being acted on by a lever which extends from said inner chamber through said further passageway to a position outside of said nozzle body, said lever being connected outside the nozzle body to motor means supported by the nozzle body, and arranged to impart said axial motion to the closing member via said lever.

2. A nozzle as claimed in claim 1 wherein said lever is a two-armed lever pivotally mounted with respect to said nozzle body at a point intermediate its ends, one end of said lever acting on said one end of the closing member and the other end of said lever being connected to said motor means.

3. A nozzle as claimed in claim 2 wherein said motor means is a hydraulic piston and cylinder assembly.

4. A nozzle as claimed in any preceding claim wherein the portion of said passageway for the flow of plastics material adjacent said outlet end, is formed as an axial bore extending to said outlet end and wherein said rod is of a diameter substantially less than said bore to provide an annular cross-section space for the passage of plastics material, the end of said rod remote from said one end of the closing member tapering frusto-conically.

5. A nozzle as claimed in claim 4 wherein said rod is formed adjacent said tapered end with lateral projections which engage the wall of said bore and help to support the rod.

6. An injection moulding machine which includes an injection tube having heating means, at least one mould having a filling port and a nozzle as claimed in any preceding claim, detachably mounted on one end of said injection tube, the filling port of the mould having a mouth with which an end portion of said closing member remote from said one end thereof can co-operate to close the filling port in the projected position of the closing member after completion of the injection of plastics material into the mould.

7. An injection moulding machine as claimed in claim 6 including a nozzle as claimed in claim 4 or claim 5, wherein the filling port of the mould has a tapering mouth complementary with the tapering end of said rod.

8. A nozzle for an injection moulding machine substantially as hereinbefore described with reference to and as shown in Figures 1 to 4 of the accompanying drawings.

9. An injection moulding machine substantially as hereinbefore described with reference to and as shown in Figures 1 to 4 of the accompanying drawings.

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1306697 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG.1

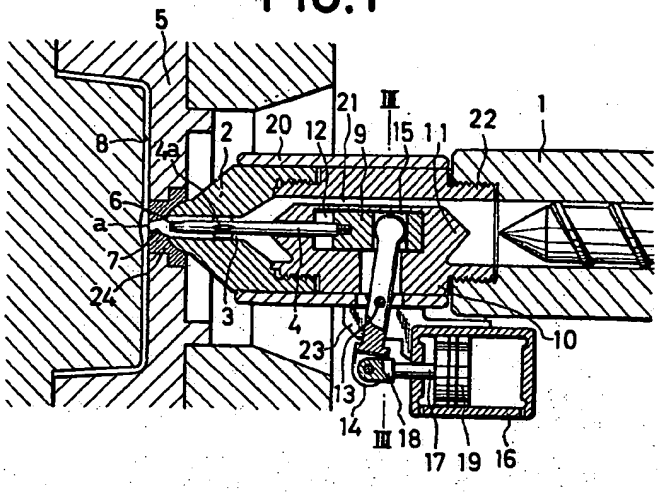


FIG.2

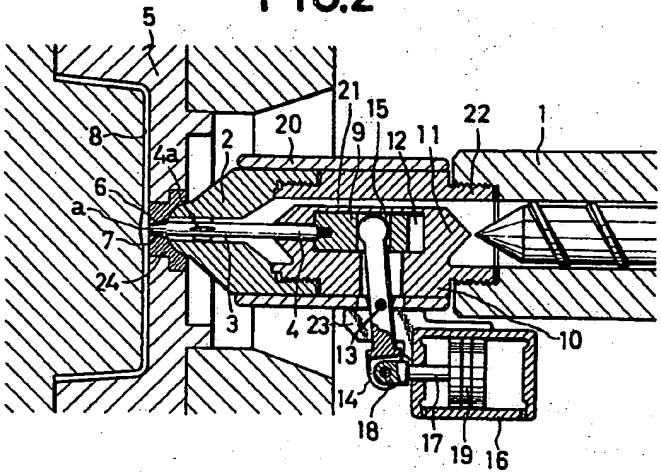


FIG.4

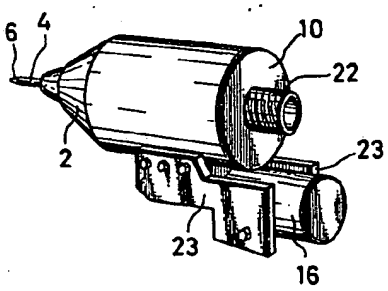
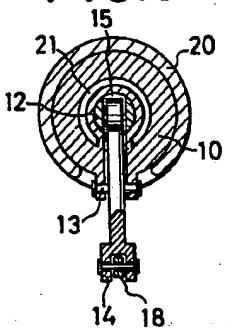


FIG.3



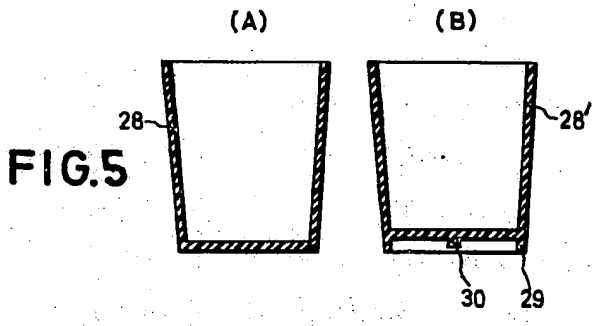


FIG.5